

The TMIS Life-Cycle Process Document

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Space Station Freedom Program Office

Revision A

November 1991

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Reston, Virginia

REVISION NOTICE

FOR

THE TMIS LIFE-CYCLE PROCESS DOCUMENT

REVISION A – NOVEMBER 1991

Incorporating SSCBD: BB003037, eff. 11-18-91

Robert P. Wilson /s/ for	11/20/91
Executive Secretary,	Date
Level II Space Station Control Board	

CHANGE INSTRUCTIONS

1. File the attached in a three-ring binder as indicated below:
2. Please remove SSP 30542, TMIS Life-Cycle Development Process Document, dated July 1991, and replace with SSP 30542, Revision A, The TMIS Life-Cycle Process Document, dated November 1991.
3. Sign and date this page in the space provided below to show that the changes have been incorporated, and file immediately behind the Revision Page.

_____	_____
Name of person incorporating changes	Date

IMPORTANT NOTE

The Configuration Management Office maintains an index of all SSCB baselined documentation. The SSFP Baseline Activity Index and Status Report (BAISR) is updated weekly and is available in the SSFPMail bulletin board SSCB or the PALS collection *SSPWORK*.

REVISIONS

REV.	DESCRIPTION	PUB. DATE
A	BASLINE ISSUE (REFERENCE SSCBD BB000729A EFF 05-21-91)	05-91
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SPACE STATION FREEDOM PROGRAM OFFICE
THE TMIS LIFE-CYCLE PROCESS DOCUMENT
NOVEMBER 1991

PREFACE

The TMIS Life-Cycle Process Document, SSP 30542, provides an overview and general guidance on the phases and activities that comprise the life-cycle process as applied to the procurement and/or development of Programwide technical and management data processing products and data base applications.

This document contains an introduction and subparagraphs on TMIS life-cycle process concepts, TMIS life-cycle activities, major TMIS reviews, documentation, and implementation of TMIS life-cycle process.

The contents of this document are intended to be consistent with the tasks and products to be prepared by NASA Work Package Centers and Space Station Freedom Program (SSFP) participants as defined in SSP 30000, Space Station Program Definition and Requirements Document. The TMIS Life-Cycle Process Document shall be implemented on all new SSFP contractual and internal activities and shall be included in any existing contracts through contract changes. This document is under the control of the Space Station Control Board, and any changes or revisions will be approved by the Deputy Director.

R. W. Moorehead /s/

11/18/91

Deputy Director,
Space Station Freedom Program and Operations

Date

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1.0 INTRODUCTION

The TMIS Life Cycle Process Document describes the processes that shall be followed in the definition, design, development, test, deployment, and operation of all Technical and Management Information System (TMIS) products and data base applications. This document is a roll out of TMIS Standards Document (SSP 30546).

1.1 PURPOSE

The purpose of this document is to define the life cycle methodology that the developers of all products and data base applications and any subsequent modifications shall follow. Included in this methodology are descriptions of the tasks, deliverables, reviews, and approvals that are required before a product or data base application is accepted in the TMIS environment.

1.2 SCOPE

The TMIS Life Cycle Process Document provides an overview of the phases and activities that comprise the life cycle process as applied to the procurement and/or development of Programwide technical and management data processing products and data base applications. These include commercial-off-the-shelf (COTS) system software, application software packages, hardware, and network components, as well as data base applications that are procured and/or developed to support the Space Station Freedom Program (SSFP). The TMIS Life Cycle Process Document shall not apply to Flight Software.

Programwide technical and management data processing products and data base applications are defined as all those to be shared among SSFP levels I, II, and III; NASA centers; other organizations; and International Partners in support of SSFP activities.

The TMIS Life Cycle Process Document is intended to provide general guidance on the phases and activities to be incorporated into the procurement and/or development of Programwide data processing products and data base applications. This document will be maintained as a TMIS baseline document; a series of enabling procedures, described in Section this document, will be maintained as part of the TMIS Policy and Procedures Manual.

Developing organizations are responsible for creating or modifying their internal operating procedures so that they are in accordance with the TMIS Life Cycle Document and the TMIS Office Enabling Procedures.

1.3 PRECEDENCE

In case of conflict between this document and SSP 30000, Space Station Program Definition and Requirements Document, the requirements of SSP 30000 take precedence.

1.4 DELEGATION OF AUTHORITY

This document is the responsibility of the Space Station Freedom Program Office (SSFPO), TMIS Office. This document is subject to Level II TMIS Control Board change control.

1.5 WAIVER/DEVIATION

Any request for waiver or deviation from this standard shall be made to the SSFPO, TMIS Office, in accordance with SSP 30000 Section 2 Part 9.

2.0 DOCUMENTS

The following documents of the date and issue form a part of this document to the extent specified herein. “(Current Issue)” is shown in place of the specific date and issue when the document is under Level II TMIS Control Board control. The current status of documents shown with “(Current Issue)” may be determined from the SSCB Executive Secretary or from the Baseline Activity Index and Status Report available in SSFPmail.

2.1 APPLICABLE DOCUMENTS

The documents in this paragraph are applicable to the extent specified herein.

DOCUMENT NO.	TITLE
SSP 30000 Section 8 (Current Issue) Reference	PDRD, Technical and Management Information System Paragraph 1.3
Section 2 Part 9 (Current Issue) References	Configuration Management Requirement Paragraphs 1.5, 4.1.3.3
SSP 30535 (Current Issue) References	TMIS Information Engineering Methodology (TIEM) Paragraphs 4.1, 4.1.3.1, 5.5.1
SSP 30536 (Current Issue) References	TMIS User Documentation Style Guide Paragraphs 4.2.3.4, 4.2.3.6, 5.5.1
SSP 30541 (Current Issue) References	TMIS Security Requirements Paragraphs 4.2.3.5, 5.5.1
SSP 30543 (Current Issue) Reference	TMIS Application Development Standards Paragraph 5.5.1
BB000949A References	Program Function Model Paragraphs 4.0, 4.1
N/A Reference	TMIS Procedure 90-01, Security Certification Paragraph 4.2.3.5

N/A References	TMIS Problem Reporting Enabling Procedure Paragraphs 4.1.3.4, 4.3.2, 5.5.2
N/A References	TMIS System Certification Enabling Procedure Paragraphs 4.2.1.3, 4.2.1.5, 4.2.1.6, 5.5.2
TSS 30551 Reference	SSFP Data Naming Standards Paragraph 5.5.1
BB000851C Reference	Program Data Model Paragraph 4.2.1.1
N/A References	TMIS Life Cycle Process Management Enabling Procedure Paragraphs 4.2.3.1, 5.1, 5.4, 5.5.2, 5.5
N/A References	TMIS Documentation Management Enabling Procedure Paragraphs 4.2.3.2, 4.2.3.3, 4.2.3.5, 4.3.3.4, 4.4.1.1, 4.4.2, 4.4.3.1, 4.4.3.2, 5.5.2
N/A References	TMIS Host System Standards Enabling Procedure Paragraphs 4.2.3.5, 5.5.2
N/A Reference	TMIS Configuration Management and Product Assurance Enabling Procedure Paragraph 5.5.2

3.0 LIFE CYCLE PROCESS MODEL

Figure 3.0-1 The TMIS Life Cycle Process Model consists of five elements:

- Phases
- Processes
- Reviews
- Documentation and Software
- Supporting Facilities

Each of the model elements is further described below.

3.1 PHASES

The end-to-end time frame of a TMIS product spans the following five sequential phases of activity:

- Requirements Phase
- Design and Development Phase
- Test Phase
- Deployment Phase
- Operational Phase

The modification of an operational system will follow this same sequence of activities. These phases are further described in Section 4 of this document.

3.2 PROCESSES

Each phase of the TMIS life cycle process model consists of one or more processes. These processes are described in detail in Section 4 of this document.

3.3 REVIEWS

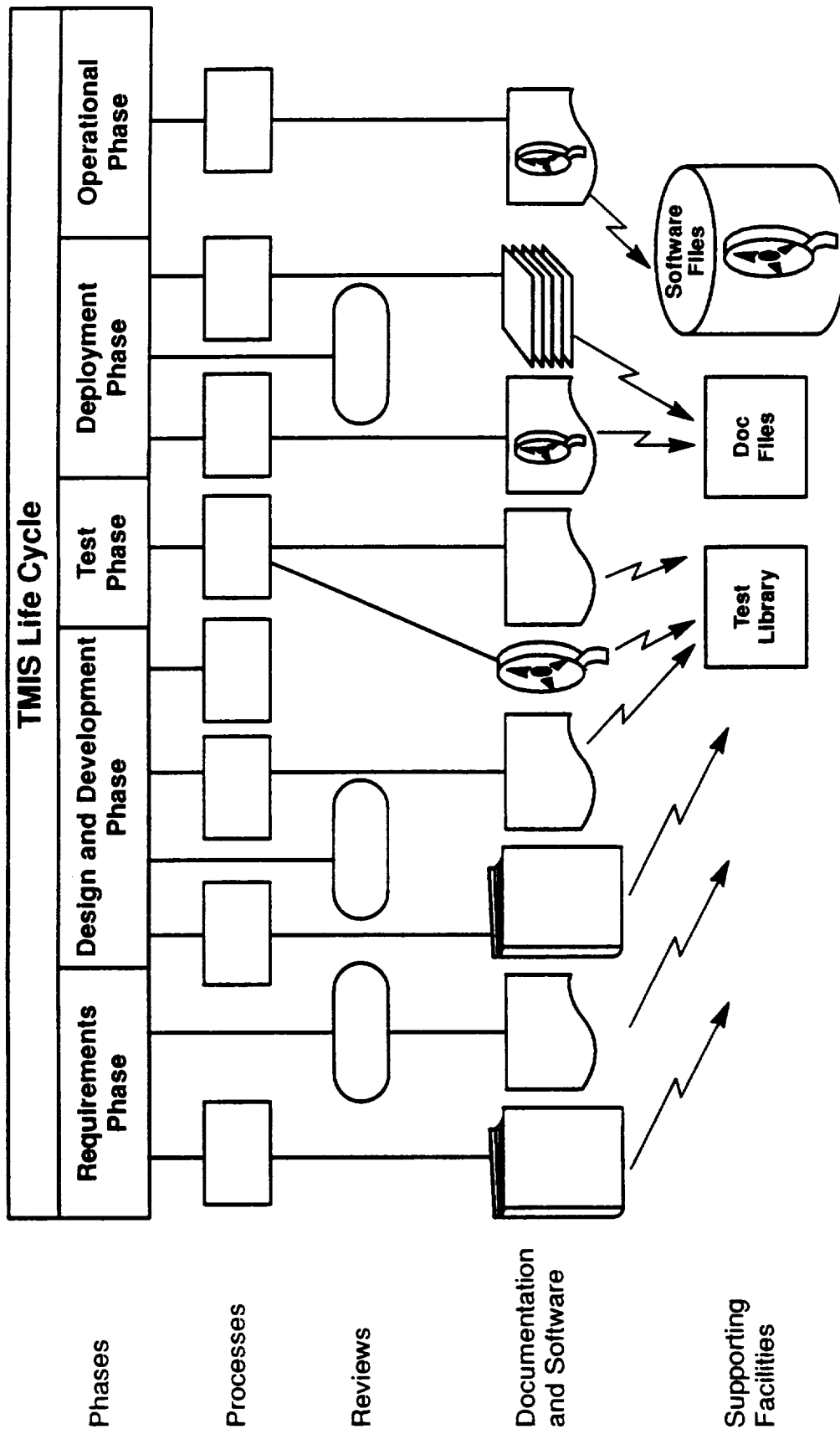
Technical reviews are significant to the continuation of subsequent processes or installation. These reviews are further described in Section 4 of this document.

3.4 DOCUMENTATION AND SOFTWARE

Within each phase, and generally related to one of the processes, documentation or software outputs are identified. The specific descriptions are included in Section 4 of this document.

3.5 SUPPORTING FACILITIES

As an adjunct to preparing, collecting, and storing life cycle outputs, several physical and electronic media facilities are employed and configuration managed to ensure the integrity and retention of life cycle deliverables. These facilities are described in Section 4 of this document.



3.0.-1 TMIS LIFE CYCLE PROCESS - MODEL STRUCTURE

4.0 LIFE CYCLE PROCESS DESCRIPTION

The decision to undertake development or addition of a TMIS product shall be made as a result of a tactical planning process that aligns TMIS capabilities and resources with support for critical Space Station Freedom Program functions. The totality of these functions is represented in the Program Function Model (PFM). The PFM is the starting point for identifying and prioritizing development activities that support SSFP functions in each phase of the SSFP life cycle. Once a need has been determined and prioritized within the context of the PFM, the ensuing development process enters the sequence described in this TMIS Life Cycle Process Document.

The TMIS implementation philosophy emphasizes the importance of having user-representatives intimately involved throughout the requirements, design and development, and testing phases. While the phases of the life cycle process are sequential, their relative duration will depend on the complexity and number of activities that will take place within each phase.

The following paragraphs describe each phase of the TMIS life cycle process as well as the other model elements (i.e., processes, reviews, and deliverables) and are keyed to the model elements shown in Figures 4.0-1 and 4.0-2, TMIS Life Cycle Process Model – Process Flow Diagram.

4.1 REQUIREMENTS PHASE

The objective of the Requirements Phase is to establish a definitive statement of requirements for a product or data base application. The need for the product or data base application shall be identified prior to the Requirements Phase through the tactical planning process, which utilizes the Program Function Model. An SSFP Office of Primary Responsibility (OPR) shall be identified to further specify the requirements for the product. Appendix A of SSP 30534 contains the definition of an OPR.

Documentation of the requirements may take the form of a Detailed Functional Requirements Document (DFRD) or a Requirements Definition Document (RDD). The requirements may be derived from the SSFP Program Function Model, an information system need identified by an SSFP Office of Primary Responsibility, or a required contract deliverable. The requirements must be defined and documented such that the resulting product can be verified against the requirements. Formal review and joint TMIS Office/developer/OPR approval of the requirements and resource allocation is necessary before proceeding into the design and development phase.

4.1.1 REQUIREMENTS DEFINITION PROCESS

Requirements definition is the first process of the TMIS life cycle. This process involves the identification, analysis, and documentation of requirements that describe a TMIS user

need. This process also involves the definition of the overall concept, strategy, and scope associated with the TMIS component. The importance of this first process lies in the fact that the defined requirements form the basis for all subsequent life cycle activities.

The objective of the requirements definition process is to define and document a set of testable and verifiable requirements that address all aspects of the desired product including, but not limited to, functional requirements, data requirements, and operating system requirements.

Definition of requirements is accomplished through the combined interactions of the TMIS Office, the contractor responsible for development of the product, and representatives of the sponsoring Office of Primary Responsibility.

The requirement for a new product or data base application is documented in a Requirements Definition Document (RDD) or Detailed Functional Requirements Document (DFRD). Changes to an existing product or data base application are documented in a Change Request (CR) written against an existing RDD or DFRD. Discrepancies or problems with a product or data base application are documented in a Problem Report (PR) and constitute a requirement to make changes to an as built product to bring it in line with an RDD or DFRD.

4.1.2 REQUIREMENTS REVIEW

The requirements document is generated, reviewed, and approved by the TMIS Office, the contractor responsible for the development of the product, and the user community as appointed by the Office of Primary Responsibility.

This review occurs after the requirements have been defined and documented. Approval of the requirements signifies that the TMIS Office, the Office of Primary Responsibility representative, and the developer endorse the requirements as valid and in agreement with SSFP/TMIS standards and that approval to proceed with implementation is authorized. The requirements documents shall be made available to the reviewers ten working days prior to the requirements review. Requirements are then submitted to the TMIS Control Board for baselining.

Implementation of the product or data base application addressing the approved requirements may be facilitated by one or more production deployments (i.e., a phased implementation). All requirements that are approved by the TMIS Office and baselined by the TMIS Control Board have been reviewed and are deemed reasonable, implementable, and affordable by TMIS.

4.1.3 REQUIREMENTS DOCUMENTATION

The principle product of the requirements phase is a definitive description of a required component as compiled in a formal requirements document. This requirements document may take one of several forms as described in the following paragraphs.

4.1.3.1 REQUIREMENTS DEFINITION DOCUMENT

The TMIS RDD is used to document application requirements defined in this life cycle phase. The RDD is defined in Appendix A of the TMIS Information Engineering Methodology (TIEM), "Annotated Outline," as baselined by the TMIS Control Board. This format shall be followed when the requirement is derived from development tasks related to the Program Function Model.

Upon approval following the requirement review process, the RDD is submitted to the TMIS Control Board to be baselined.

4.1.3.2 DETAILED FUNCTIONAL REQUIREMENTS DOCUMENT

In the case of vendor-provided or commercial-off-the-shelf (COTS) products, the requirements shall be documented in a TMIS DFRD and baselined by the TMIS Control Board. In this case, the requirement is documented in an extraction of applicable product documentation along with supporting technical specifications.

4.1.3.3 CHANGE REQUESTS

The process for documenting a Change Request (CR) is defined in SSP 30000 Section 2 Part 9.

4.1.3.4 PROBLEM REPORTS (PR)

The process and format for documenting a problem with an operational TMIS product or data base application is defined in the TMIS Problem Reporting enabling procedure.

4.2 DESIGN AND DEVELOPMENT PHASE

The objective of the Design and Development Phase is to design and develop a product or data base application that satisfies the defined requirements. Based upon the documented requirements, a make/buy decision will be made resulting in either the preparation of a product specification to be released for competitive procurement, the assignment of a design and development task to a development organization, or a combination of the two. Current procurement procedures will be followed if a decision is made to purchase the product. The end result of this phase is a product that has been developed to satisfy the documented requirement and is ready for test and formal certification.

4.2.1 DESIGN AND DEVELOPMENT PHASE PROCESSES

4.2.1.1 DESIGN/SPECIFICATION PROCESS

The TMIS life cycle emphasizes an iterative process toward the accomplishment of the design and development of the product. The activities associated with this phase involve

both the logical and physical design of the product. Where applicable, the design of the product is reviewed against the global TMIS models (e.g., the TMIS Program Data Model ICDs) to ensure the feasibility and viability of the proposed design. Ensuring the integration of the product with other products, existing and planned, is of prime importance during this design activity.

A product architectural design shall be established prior to beginning any unit code development. At a minimum, this architectural design for data base applications shall include the logical data model and the associated data dictionary. Subsequent detailed design activities associated with the product are frequently conducted in an iterative process with unit code development (e.g., screen formats, interfaces, report format definitions).

The design information is incorporated into the design book and carried forward with other design information as part of the as built documentation package.

Representatives of the OPR shall participate throughout the Design and Development Phase. This participation is generally facilitated through the use of passive and/or active prototypes, Joint Application Design (JAD) sessions, and technical reviews. These activities are sponsored and conducted by the TMIS Office, the OPR, and the contractor responsible for the product's development.

Early in the Design and Development Phase, the requirements for user training, production support, and user documentation are established with the OPR as the representative of the end users. Preparation for training, user support, and user documentation is incorporated into the implementation plan/schedule.

4.2.1.2 ACQUISITION OR DEVELOPMENT PROCESS

The product is parceled into appropriate units (modules) in order to facilitate effective development and associated technical reviews. The specific activities associated with this development effort are highly dependent upon the nature of the product. A product involving the acquisition of commercial-off-the-shelf (COTS) software, for example, will follow different development processes than does a product that is entirely developed by a contractor using existing TMIS software and hardware.

For products developed by a contractor, a requirements traceability matrix for the entire RDD is established at this time and included in the product's design book, which is carried forward as part of the as built documentation package. This matrix is used throughout the unit code development process to link developed units with their associated requirements.

4.2.1.3 TEST PLAN AND SCRIPT PREPARATION PROCESS

An integral part of the Design and Development Phase is the definition and development of the various test scripts associated with testing and validating the product. These

scripts may include unit tests, application and system integration tests, benchmark tests, and stress tests. As part of the preparation of the scripts, a general approach or plan and testing instructions are also prepared.

A primary objective is to automate the testing activity to the greatest extent possible. This objective is accomplished through the definition of testing scenarios that demonstrate the capability of the product to perform in the environment defined by the user, the translation of those scenarios into test scripts (i.e., the definition of specific key-strokes or actions required to execute the test scenarios), and conversion of the test scripts into the technical language of the specific automated testing tool chosen to support the product's development.

Detailed information concerning the development of test scripts, TMIS automated testing tools, and TMIS test script libraries is contained in the TMIS System Certification enabling procedure.

The test scripts are carried forward with other design information as part of the documentation package.

4.2.1.4 UNIT TEST PROCESS

Unit tests are executed and results of the tests are recorded by the contractor responsible for developing the product. Unit test scripts are executed by the contractor responsible for developing the product, and results of the tests are recorded. The results of each test are reviewed by the development team, and discrepancies are either addressed by appropriate corrective actions or carried forward as a discrepancy. Unit tests are then re-executed against corrected units to verify that identified discrepancies have been properly resolved.

The unit test scripts and the results of the unit tests are carried forward with other design information as part of the documentation package.

4.2.1.5 PRELIMINARY BENCHMARK TEST PROCESS

Benchmark tests are included in the development life cycle of a product as a means to measure the impact of changes on the performance of the product, as well as to establish an initial benchmark performance measurement for the product. These measurements include, but are not limited to, CPU time consumed, I/Os expended, wall-clock execution time, and memory usage.

During the unit code development, preliminary benchmark tests are executed to validate the test scripts and determine the performance characteristics of the units being developed. The results of these tests may be compared with previous benchmarks of the product to determine the impact of changes that have been made to the product. The

results of these tests may also be compared against anticipated results and/or established TMIS standards and guidelines. Problems identified during these tests are to be addressed with appropriate corrective actions and follow-up testing.

Benchmark tests run during the development phase of the life cycle are usually run in the development environment of the TMIS host. This differs from the final benchmark tests executed later in the life cycle; final benchmark tests are usually executed in a dedicated test environment without interference or contention with any other product.

The benchmark test process is further discussed in the TMIS System Certification enabling procedure.

4.2.1.6 PRELIMINARY STRESS TEST PROCESS

Stress tests are conducted against an emerging product to measure the product's performance in response to simulated loads. Such loads may include concurrent user access of the product, "worst case" data base sizing, concurrent execution of processes within the product, communication network loading, etc.

Similar to the benchmark test, the stress test is used to identify performance characteristics of the developing product, and/or to identify performance concerns associated with the product. The results of these tests may be compared against anticipated results and/or established TMIS standards and guidelines. Problems identified during these tests are to be addressed with appropriate corrective actions and follow-up testing.

The stress test process is further discussed in the TMIS System Certification enabling procedure.

4.2.2 DESIGN AND DEVELOPMENT PHASE REVIEWS

Throughout the development process, the TMIS Office, the OPR, and the contractor responsible for developing the product participate in technical reviews of the developing product. These technical reviews focus on various aspects of the developing product including data base design conformance to TMIS standards, effective coding techniques, comparison of "as built" to "as-required," detailed screen/report specifications, results of code walk-throughs, functional demonstration of emerging capabilities, etc.

One key review early in the Design and Development Phase is the Architecture Design Review. This review is conducted when the appropriate design media and documentation have been completed; reviewed by appropriate parties; and approved by the TMIS Office, OPR, and contractor representatives. This review is the point where impacts of the design upon respective functional organizational responsibilities and other TMIS products and resources are determined and reconciled.

4.2.3 DESIGN AND DEVELOPMENT PHASE DOCUMENTATION

4.2.3.1 IMPLEMENTATION SCHEDULE

An implementation schedule to be used in managing and providing implementation visibility shall be required.

The implementation schedule shall contain a level of activity and milestone detail that can be mapped to the processes, reviews, and outputs identified in the TMIS Life Cycle Process – Process Flow Diagram (Figures 4.0–1 and 4.0–2). The implementation schedule is an activity schedule showing tasks, related flow times, and task dependencies.

The implementation schedule is the tool used by the project team managers and members to manage and monitor progress of the project. It is at this level that specific reviews, approvals and deliverables are tracked and responsibilities identified. Details and schedule templates are included in the TMIS Life Cycle Process Management enabling procedure.

4.2.3.2 DESIGN BOOK

During the Design and Development Phase of the TMIS life cycle, a design book is established. This design book is regarded as a dynamic document in that information associated with each subsequent phase or activity in the development of the product is added to the document (e.g., logical design, physical design, unit code test results). The contents of this document are the subject of the various technical reviews conducted throughout the remainder of the product's life cycle.

The format for the design book is contained in the TMIS Documentation Management enabling procedure.

4.2.3.3 TEST PLAN SCRIPTS AND PARAMETERS

The test scripts provide the test code procedures and specific test scenario parameters and instructions to be applied to the testing of a product. They include unit tests, installation tests, application and system integration tests, benchmark tests, and stress test scenarios. The test scripts form the plan for the overall testing and certification approach.

The TMIS Documentation Management enabling procedure contains the formats for the development of the test scripts.

4.2.3.4 USER DOCUMENTATION

User documentation in the form of handbooks, reference manuals, and/or user's guides provide instructions to the end user on how to effectively use the product. They include

detailed instructions covering start-up, diagnostics, help, screen flows, error recovery, and other information that enables the user to interface with the product. All user documentation materials shall be reviewed by the appropriate parties and approved by TMIS-O, OPR and developer.

The TMIS User Documentation Style Guide contains the standard for the development of user documentation.

4.2.3.5 OPERATIONS MANUAL

The operations manual provides system operators and administrators with procedures required to operate the product. It includes monitoring procedures, backup and recovery procedures, scheduled jobs required for normal operation of the application, safety and security procedures, and output distribution procedures associated with the product. The specific instructions for installing the product into the host production environment are included in the operations manual. All Operations Manuals shall be reviewed by the appropriate parties and approved by TMIS-O, OPR and developer.

The TMIS Host System Standards enabling procedure provides the TMIS system standards for application developers (e.g., system configuration, general operating procedures, disk space allocation and management guidelines). An outline for an operations manual is provided in the TMIS Documentation Management enabling procedure.

4.2.3.6 TRAINING MATERIALS

Training materials provide the necessary lesson plans, presentation materials, and student handouts for conducting a practical course on the use of the product. The requirement for and scope of training materials will be determined by the TMIS Office in concert with the OPR. All training materials shall be reviewed by the appropriate parties and approved by TMIS-O, OPR and developer.

The TMIS User Documentation Style Guide contains the standard for the development of training materials.

4.2.3.7 UNIT TEST RESULTS

The unit test results show the outcome of the scripts executed during the unit tests. The results are summarized on a cover sheet listing the units tested and any subjective comments and conclusions, followed by the collection of the scripts documenting actual results with the pass/fail status and execution times for the scripts.

4.3 TEST PHASE

The objective of the Test Phase is to accomplish the following:

- (1) Functionally validate the procured or developed product or data base application as satisfying the documented requirements.
- (2) Measure and accept the product's performance via benchmark and stress test analysis.
- (3) Certify that the product is ready for installation into the TMIS production environment.

It is also at this point, using the installation instructions, that the product or data base application code is migrated into the test environment and placed under configuration control disciplines.

4.3.1 TEST PHASE PROCESSES

4.3.1.1 INSTALLATION TEST PROCESS

The installation test involves two primary activities:

- (1) Preparing the instructions for installing the software into the integration environment. These will be the same instructions used eventually to install the software into the production environment.
- (2) Testing the installation instructions.

The installation test is a simulation of the production installation procedures. The results of the installation test are reviewed by the development team and discrepancies are addressed by appropriate corrective actions. The installation test is then re-executed to verify that identified discrepancies have been properly resolved.

The development team is responsible for execution of the installation test.

Installation procedures and the results of the installation test are carried forward with other design information as part of the as built documentation package.

4.3.1.2 PRODUCT OR APPLICATION INTEGRATION TEST PROCESS

Upon the successful completion of all unit code tests, the emerging product is subjected to product integration testing. At this stage all units of the emerging product are brought together and tested as a single entity. The purpose of this integration test is to ensure that all units function in concert with each other.

Product integration testing involves both those units which were modified or newly developed during the product's life cycle as well as existing units of the product which

were not modified. The integration tests ensure that modified units function in concert with existing, unmodified units.

The results of the integration test are reviewed by the development team and discrepancies are addressed by appropriate corrective actions. Appropriate tests are then re-executed to verify that identified discrepancies have been properly resolved.

The development team is responsible for conducting the product integration tests. Test scripts and test results are carried forward with other design information as part of the as built documentation package.

4.3.1.3 SYSTEM INTEGRATION TEST PROCESS

The system integration test is similar to the product integration test except that the objective is to ensure that the emerging product, as a single entity, executes in concert with other TMIS production products. This integration test includes verification that the emerging product interfaces appropriately with other TMIS production products as designed. Additionally, this test ensures that the emerging product does not negatively interfere or contend with any other production products or with the TMIS host system.

The results of the system integration test are reviewed by the development team and discrepancies are addressed by appropriate corrective actions. Appropriate tests are then re-executed to verify that identified discrepancies have been properly resolved.

The development team is responsible for conducting the system integration tests. Test scripts and test results are carried forward with other design information as part of the as built documentation package.

4.3.1.4 BENCHMARK TEST PROCESS

Benchmark tests are constructed to measure performance of an application in order to establish that the product, as designed and developed meets the stated performance requirements. The performance measurements provide a baseline of statistics against which future software enhancements can be measured or for use in measuring results of a regression test.

Benchmark testing is performed in the test environment, that is, the same mainframe using the same operating system and support software that will be used in the production environment. No other applications will be operating during this test.

Benchmark test scenarios are constructed from the unit and/or integration test scenarios by the test analyst and are maintained in the test library. These scripts encompass all interactive capabilities of the application.

Test reports and supporting documentation such as test result logs, problem report descriptions, and problem report resolutions are also forwarded to the test library.

4.3.1.5 STRESS TEST PROCESS

Stress testing is performed on selected application software to determine what effect user workload has on performance and to determine when increasing user workload causes an overload condition to occur.

The stress test is conducted following a successful benchmark test. A portion of the benchmark script will be run to create real-time loading conditions for the application. The stress test will usually be executed using the same data base and environment configuration used in the benchmark testing. A portion of the script will be extracted, refined, and executed in multiple sessions to simulate various user workloads.

Statistics are gathered from these stress tests in an attempt to locate potential bottlenecks in the application processing configuration. Application and system performance tuning is performed by developers to eliminate bottlenecks. Tests are repeated as required. Applications must pass the stress test criteria before being installed into production.

Stress test scripts must be selected with a high degree of participation by the OPR representing the user community. The OPR as the interface with the user determines the percentage of utilization of the functional capabilities so that the stress test scripts can adequately reflect the user's perception of anticipated utilization.

Stress test scenarios, cases, and procedures are prepared by the test analyst and are maintained in the test library. Test reports and supporting documentation such as test result logs, problem report descriptions, and problem report resolutions are also forwarded to the test library.

4.3.1.6 CERTIFICATION PROCESS

The certification process provides security certification and system certification.

The security certification process determines whether the application meets the documented and approved system security specifications. It also validates that the results of the integration test demonstrate that the security provisions are adequate for the application's protection.

Following the installation tests, but prior to the Operational Readiness Review (ORR), the test scripts, test logs, and test data are reviewed for completeness.

The system certification process validates that a comprehensive set of tests; including the unit, installation, product or application integration, system integration, benchmark, and stress tests; were conducted and documented. The primary focus is to ensure that requirements are fully tested and that life cycle methodology standards and guidelines were followed.

The TMIS implementation philosophy emphasizes the importance of having user-representatives intimately involved throughout the requirements, design and

development, and testing phases. Based upon this involvement throughout the life cycle, the OPR certifies that the application meets the specified needs.

4.3.2 TEST PHASE REVIEWS

As the various testing processes occur during the Test Phase, a number of reviews are held to assess the results and to determine if corrective action is required. During this phase the software undergoing test is under configuration management control.

Problems and discrepancies occurring during these tests are identified and recorded according to the procedures specified in the TMIS Problem Reporting enabling procedure for tracking and resolution. Likewise, software changes must follow the established configuration management disciplines for incorporating changes into controlled software.

4.3.3 TEST PHASE DOCUMENTATION

4.3.3.1 INTEGRATION TEST RESULTS

Results of the installation tests, product or application integration tests, and the system integration tests are documented. These tests are performed prior to the release of any COTS, application, or major system software product.

The documentation contains the pass/fail test results for the enhancements included with the release followed by the pass/fail test results for tests of unmodified portions of the product or application that were required by the release.

4.3.3.2 BENCHMARK TEST RESULTS

The actual results and subjective comments and conclusions of the benchmark test are recorded including an analysis of the performance statistics (e.g., CPU time, I/Os) associated with the execution of each transaction included in the benchmark test. This analysis includes both interactive execution transactions and batch execution transactions.

4.3.3.3 STRESS TEST RESULTS

The actual results and subjective comments and conclusions of the stress test are recorded including an analysis of the stress test with emphasis on analysis of system/application performance based on simulated "normal" user workloads and "worst case" workloads.

4.3.3.4 TEST PLAN AND TEST REPORT

A test plan is prepared for each release and includes proposed testing techniques and approaches together with test scripts, test scenarios, expected results, parameters, and instructions.

Upon completion of all testing, a consolidated report is prepared documenting results from the various tests described above and as compared to the test plan.

The formats for the contents of the test plan and the test report are detailed in the TMIS Documentation Management enabling procedure.

4.3.3.5 SECURITY CERTIFICATION

Security controls are an integral part of the design of products and data base applications.

TMIS Office Security is responsible for issuing a Security Certification statement indicating that the application, product, or tool is in compliance with NASA and other federal policies, regulations, and standards covering automated information security.

If conditions exist that prevent the issuance of the Security Certification, a Conditional Certification may be issued and the product placed in production operation with a suspense date for resolution.

The requirements for security of products and data base applications are found in SSP 30541, TMIS Security Requirements document.

The policy regarding security certification is stated in TMIS Procedure 90-01, Security Certification of Sensitive Applications.

4.4 DEPLOYMENT PHASE

The objective of the Deployment Phase is to assemble, validate and place under release/configuration control the delivered and certified product and all of the required supporting documentation (e.g., user documentation, training materials, operation instructions). A formal Operational Readiness Review is conducted by the TMIS Office with "go-ahead" approval required before installation and deployment of the product is initiated. This phase is concluded when successful installation and deployment is verified and documented.

4.4.1 DEPLOYMENT PHASE PROCESSES

4.4.1.1 VERSION DESCRIPTION DOCUMENT (VDD) PREPARATION

During the Version Description Document (VDD) preparation process, the hardware and software component inventory is assembled into a single document for each product

release. Requirements and problem reports satisfied by the release, any outstanding discrepancies, the production installation instructions, and the deployment plan are compiled and added to the document. VDD contents are described in the TMIS Documentation Management enabling procedure.

VDD materials are routed for review by all TMIS-IC support services and are then updated and submitted for approval by the TMIS-IC Internal Change Board. The VDD materials are forwarded to the TMIS-IC Configuration Management (CM) library.

4.4.1.2 ASSEMBLE OPERATIONAL READINESS REVIEW (ORR) MATERIAL

During the ORR material assembly process, information from the requirements documents (RDD or DFRD), user documentation, training materials, operations manual, test reports, certifications, and VDD are summarized and then compiled into briefing charts for each product. Detailed test results are available upon request, but are not part of the ORR material.

The materials for individual products are then combined into an overall blockpoint release package, which includes a table of contents and the Release Approval signoff form. This briefing material is made available by electronic distribution for use at the remote NASA sites.

Prior to conducting the formal ORR, the briefing material is reviewed by the developer and TMIS Office management. ORR attendees are notified approximately one week prior to the ORR date.

The materials prepared for the ORR package are forwarded to the CM library.

4.4.1.3 MIGRATION TO PRODUCTION

Following ORR approval, the production installation instructions included in the VDD for each of the products are executed. Libraries and databases are reviewed to ensure that the operations were performed correctly.

4.4.1.4 DATA BASE CONVERSION AND/OR INITIAL DATA LOADING

If existing data is associated with the application or product being deployed, then a data conversion/loading process must be executed. This process usually takes the form of either converting an existing data base for use by the new product, or loading an initial set of data into the data base of the new product. Execution of this process may be performed as part of the deployment phase or may be executed at a later time after deployment as part of the operational phase. In either case, software required to facilitate this execution should be included in the life cycle phases at the same time as the application or product.

4.4.1.5 PRODUCTION VERIFICATION TEST

Following the migration of the production data base application or product, a verification process is followed that may involve running production verification scripts, running procedures to verify data base conversions, and manually examining libraries. The purpose of the verification test is to ensure that the software has been properly installed in the production TMIS environment.

A production verification report is produced by the verification team and is forwarded to the CM library.

4.4.2 DEPLOYMENT PHASE REVIEWS

The Operational Readiness Review ensures that the prepared releases of products are ready for production use. The TMIS-IC and developer team brief the TMIS Office using the contents of the ORR package.

At the review, the functional area representatives (system certification, site support, security, training, user documentation, capacity planning, operations, and independent product assurance) certify that no problems or outstanding issues remain with regard to the production use of the application or product. The deployment schedule is presented and TMIS Office approval is recommended.

Signatures on the TMIS Release Approval form are provided by TMIS Office for each product approved for deployment. The completed form is forwarded to the CM library.

The formats for the ORR presentation and the TMIS Release Approval form are provided in the TMIS Documentation Management enabling procedure.

4.4.3 DEPLOYMENT PHASE DOCUMENTATION

4.4.3.1 VERSION DESCRIPTION DOCUMENT (VDD)

The primary purpose of the VDD is to identify the hardware and software components that comprise the product. In addition, it also includes the requirements and problem reports satisfied by the release, any outstanding discrepancies, the production installation instructions, and the deployment plan.

The TMIS Documentation Management enabling procedure contains the standard for preparing Version Description Documents.

4.4.3.2 OPERATIONAL READINESS REVIEW (ORR) PACKAGE

The ORR package contains the briefing materials to be reviewed for TMIS Office approval prior to releasing software into the production environment. It includes a

statement of the requirements and problem reports satisfied by the release, a summary of the unit, integration, benchmark, and stress tests, a review of the certifications received for the product, any outstanding discrepancies, and a brief review of the status of support tasks performed in preparing the product for deployment.

The TMIS Documentation Management enabling procedure contains the format to be used in preparing the ORR package.

4.5 OPERATIONAL PHASE

The Operational Phase extends over the ongoing production operation of the product. Procedures for performance monitoring and product maintenance are established for this phase. Sustaining engineering tasks related to product upgrades and/or problem resolution are performed. As changes to the product are required, the changes are documented as a requirement and cycled back through the life cycle process.

4.5.1 TRAINING

User training is delivered as part of the Operational Phase in accordance with the implementation plan/schedule that was developed under the design and development process.

4.6 SUPPORTING FACILITIES

4.6.1 TEST LIBRARY

The test library is a collection of all current test cases and procedures used in unit, integration, installation, benchmark, and stress testing. In addition, it contains completed test results, installation instructions, and test reports.

Following an initial release of software, a complete set of tests is stored in the library. A data base of test cases and procedures is maintained for each application or product by test phase.

When software enhancements are made, the library of tests is reviewed to select tests that can be adapted for testing the enhancement, as well as tests that may be used for regression testing.

Following software enhancement releases, modified test cases and procedures are forwarded and stored in the test library.

Following each blockpoint release, the updated summary of test cases, procedures (by application and phase), and a detailed listing of test cases and procedures, is produced.

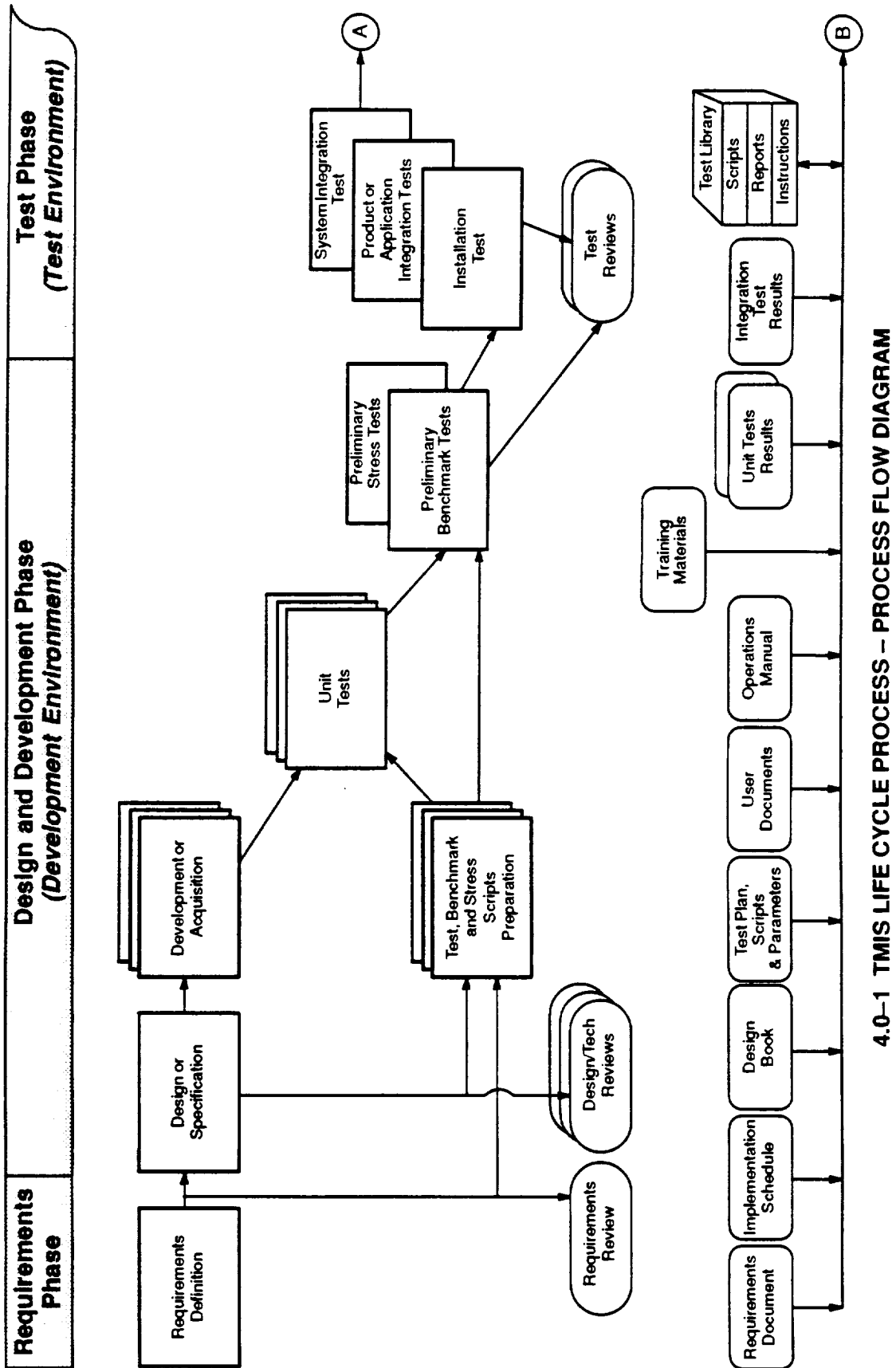
4.6.2 AS BUILT DOCUMENTATION

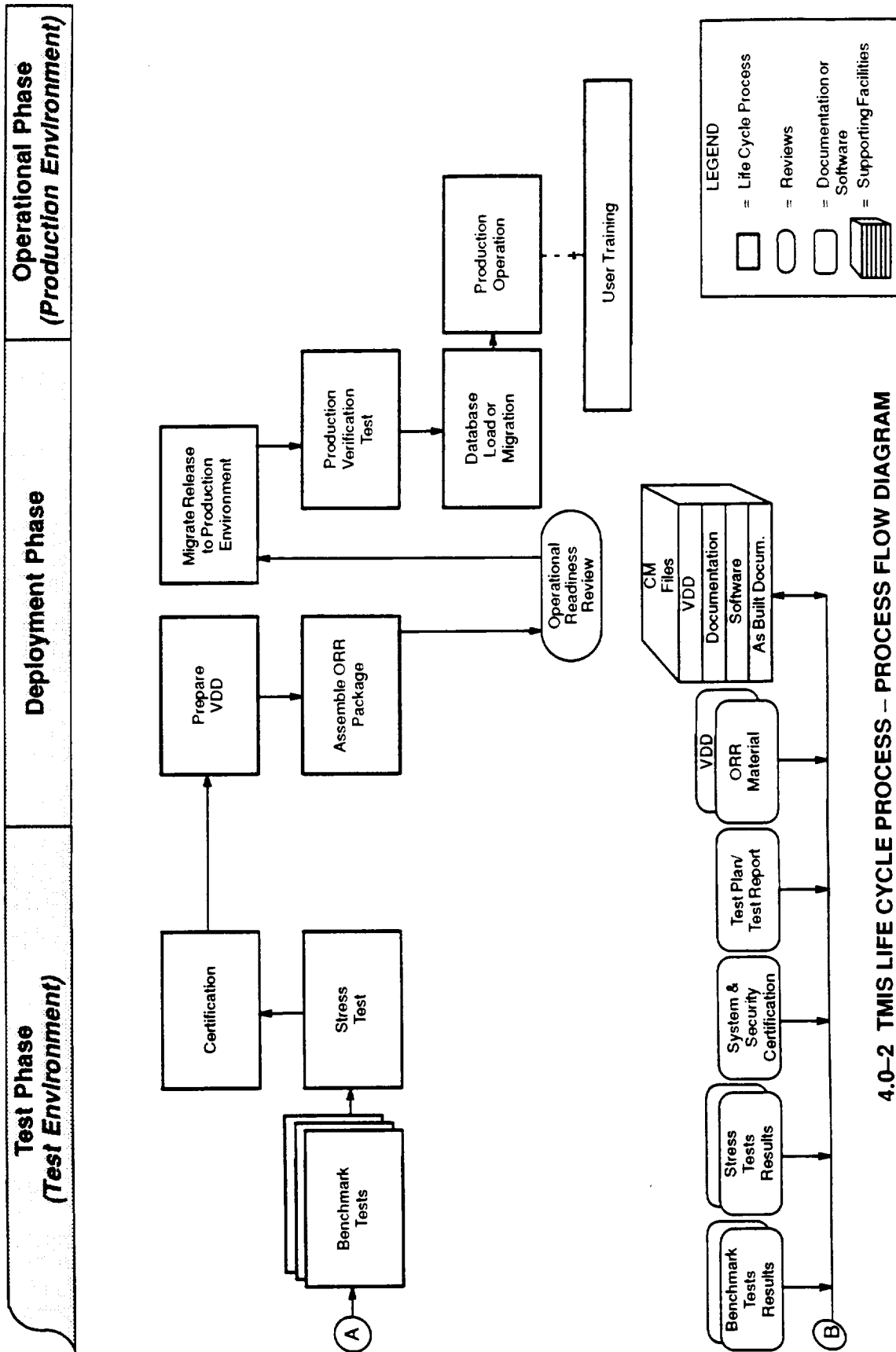
Product documentation is prepared in working form throughout the life cycle. As documentation and data are required, they are extracted from the working set of documentation and appropriately formatted and processed. At the point of ORR approval, all documentation that represents the as built version of the production release is collected and put under configuration control.

4.6.3 TMIS CONFIGURATION MANAGEMENT FILES

The TMIS-IC Configuration Management organization retains both hard copy and electronic media copy of the TMIS baselined product documentation. CM is the repository for controlling such documentation as the Version Description Document, as built documentation, etc.

Electronic media storage of TMIS baselined product software is also controlled or established by the TMIS-IC Configuration Management organization.





4.0-2 TMIS LIFE CYCLE PROCESS – PROCESS FLOW DIAGRAM

5.0 IMPLEMENTATION OF THE TMIS LIFE CYCLE PROCESS

5.1 IMPLEMENTATION TEAMS

Implementation teams are established for each development or acquisition task, with representation assigned from the functional organizations (e.g., Data Administration, Information Systems, System Certification, Operations, User Documentation Management, Engineering, Training, Site Support, Independent Product Assurance). The primary development organization provides the technical management of the project as well as the principle development or integration staff. A TMIS Office interface is assigned to each implementation team as the project manager.

The implementation team managers are responsible for accomplishing start-to-finish life cycle project tasks, using assigned functional resources.

Functional organization representatives on the implementation teams are assigned to support the implementation tasks and verify that functional disciplines and procedures have been satisfied.

Further details on implementation teams is provided in the TMIS Life Cycle Process Management enabling procedure.

5.2 LIFE CYCLE PROCESS MODEL – PROCESS FLOW DIAGRAM

The TMIS Life Cycle Process Model–Process Flow Diagram (Figures 4.0–1 and 4.0–2) is intended to serve as a guide or template for managing a project. The flow diagram identifies and interrelates a basic set of tasks and outputs from which a specific project plan and schedule can be constructed. It is recognized that each project will have unique characteristics, therefore, the template is a guide to preparing a specific project plan. Tasks and outputs may be added to provide appropriate management control and visibility. Likewise, some template items may not be applicable to the project and may be omitted as documented in the requirements document.

5.3 DOCUMENTATION

Product documentation is prepared in working form throughout the life cycle phases. At appropriate process steps, the documentation is finalized and formatted as required for baselining, distribution, and retention. Conceptually, the documentation process is a sequential stacking of the project data into one final collection during the implementation phases, as illustrated in Figure 5.3–1, TMIS Life Cycle Process–Documentation Build Up. As documentation and data are required, they are extracted from the collection,

appropriately formatted, and processed. At the point of ORR approval, all documentation that is key to defining the product release is collected and put under configuration control. This set of documentation represents the as built documentation for the production release of the product.

5.4 SCHEDULES

An activity schedule to be used in managing and providing implementation visibility shall be prepared. The schedule contains a level of activity and milestone detail that can be mapped to the processes, reviews, and outputs identified in the TMIS Life Cycle Process-Process Flow Diagram (Figure 4.0-1 and 4.0-2). The required project schedules are detailed in the TMIS Life Cycle Process Management enabling procedure.

5.5 LIFE CYCLE PROCESS DOCUMENT STRUCTURE

Documentation related to the description and establishment of the life cycle process for products is segregated into three levels of administration and control, as shown in Figure 5.5-1, TMIS Life Cycle Process Document Structure:

- Level 1 SSFP/TMIS Baselined Documents, including the TMIS Life Cycle Process Document, establish Programwide standards and direction. This level of documentation shall be maintained by the TMIS Control Board (TCB).
- Level 2 TMIS Enabling Procedures support the implementation of the life cycle process to current and future projects and tasks. These procedures shall be established and maintained in the TMIS Policies and Procedures Manual.
- Level 3 Developer/Contractor's Operating Procedures implement day-to-day processes and instructions within the developer's organization to meet the requirements established by the baselined documents and enabling procedures. This level of documentation is maintained as part of the contractor's operating procedures and is unique to the developer/contractor.

5.5.1 SSFP/TMIS BASELINED DOCUMENTS

The set of SSFP/TMIS baselined documents that establish Programwide standards and direction are:

- TMIS Information Engineering Methodology (SSP 30535)
- TMIS User Documentation Style Guide (SSP 30536)
- TMIS Application Development Standards (SSP 30543)
- TMIS Security Requirements (SSP 30541)
- SSFP Data Naming Standards (TSS 30551)

5.5.2 TMIS ENABLING PROCEDURES

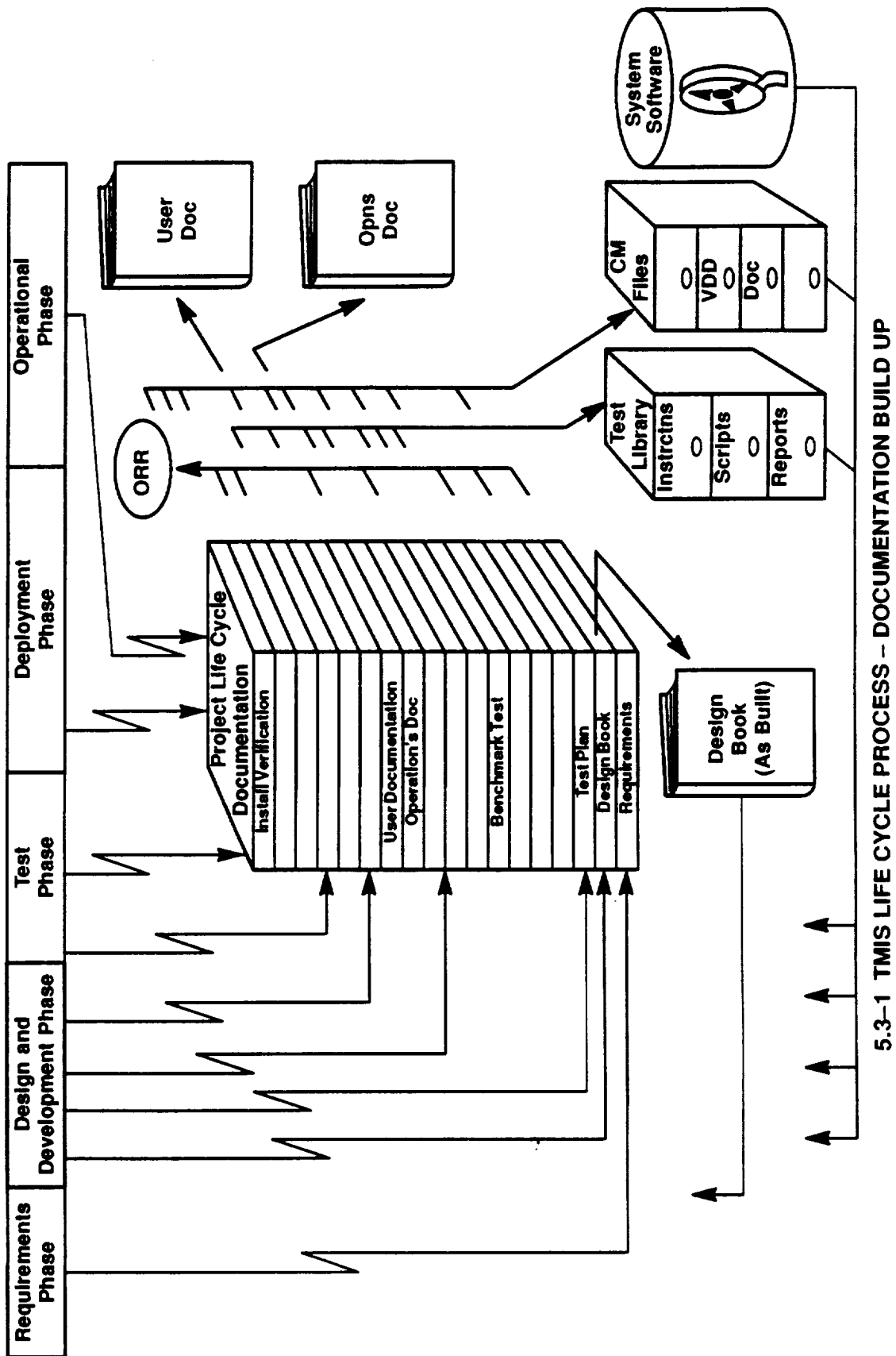
A set of TMIS-wide enabling procedures implement and support the on-going life cycle process of current and future projects and tasks. The procedures provide direction to the developer organizations and form the basis for preparation of their day-to-day operating procedures. These enabling procedures are established and maintained in a TMIS Policies and Procedures Manual by the TMIS Office.

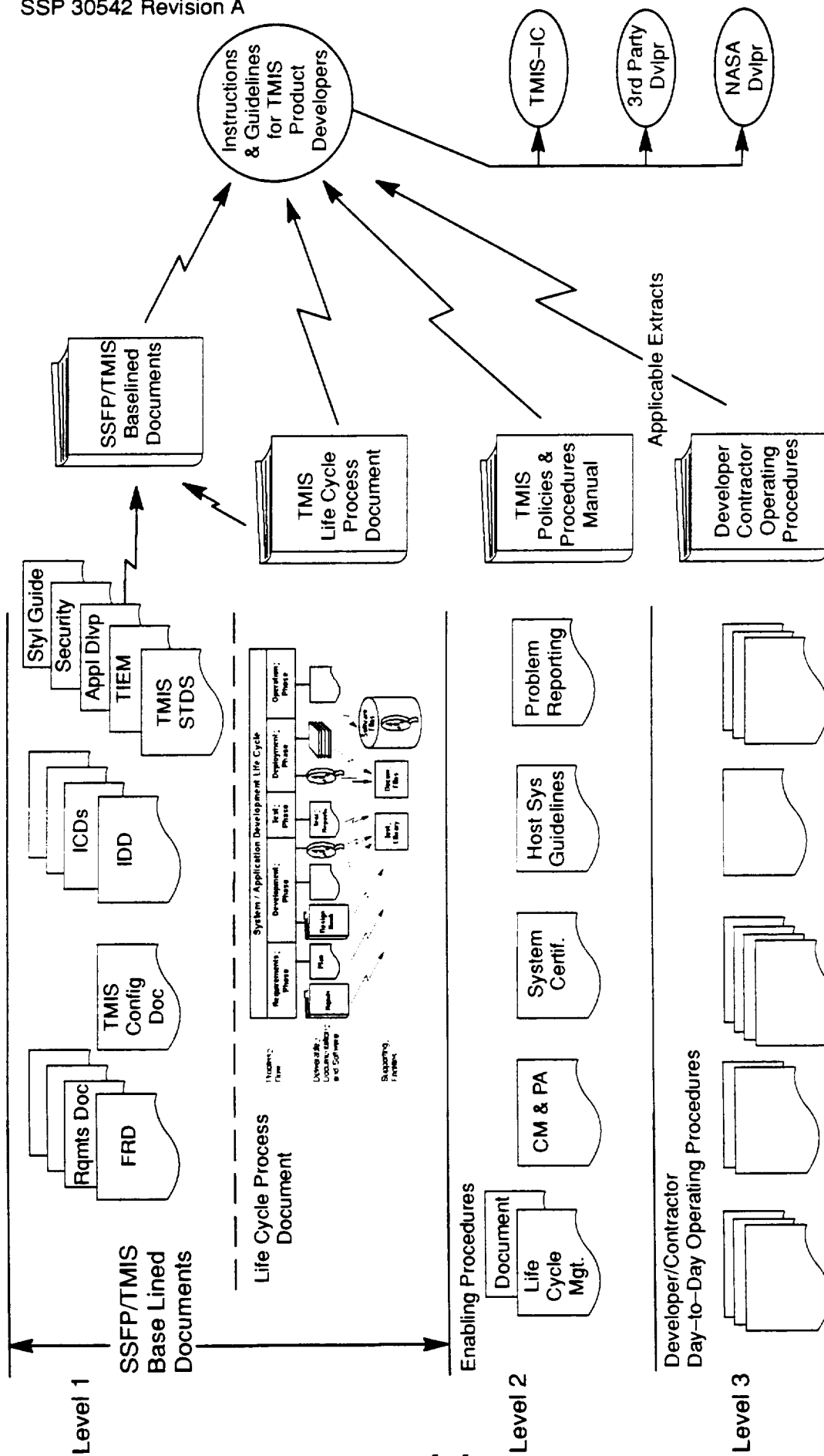
Enabling procedures specifically related to this life cycle process include:

- TMIS Life Cycle Process Management – This procedure sets forth the basic project management practices to be employed. It addresses implementation teams, team members' responsibilities, schedules, and deliverables.
- TMIS System Certification – This procedure sets forth the system certification and testing practices to be employed. It addresses testing, the test library, and security validation.
- TMIS Configuration Management and Product Assurance – This procedure sets forth the configuration management and product certification practices to be employed. It addresses software, documentation, hardware, product versioning, and release management.
- TMIS Documentation Management – This procedure addresses life cycle documentation (types and formats), document preparation and distribution, and the document library.
- TMIS Host System Standards – This procedure sets forth the guidelines to be followed when developing a data base application or implementing a product in the TMIS host environments.
- TMIS Problem Reporting – This procedure establishes the process for TMIS users to report a failure, malfunction, degradation, deficiency, or deviation against a TMIS production system or application. The procedure applies to all SSFP TMIS primary and secondary users and to any organization or activity that has a formal agreement for unique or specialized support services from TMIS.

5.5.3 DEVELOPER/CONTRACTOR OPERATING PROCEDURES

Operating procedures that implement day-to-day processes and instructions will be maintained within the developer's organization to meet the requirements established by the baselined documents and enabling procedures. This level of documentation is maintained as part of the contractor's unique operating procedures.





5.5-1 TMIS LIFE CYCLE PROCESS DOCUMENT STRUCTURE

APPENDIX A ABBREVIATIONS AND ACRONYMS

CM	Configuration Management
COTS	Commercial–Off–The–Shelf
CPU	Central Processing Unit
CR	Change Request
DFRD	Detailed Functional Requirements Document
ICD	Interface Control Document
IDD	Interface Description Document
I/O	Input/Output
JAD	Joint Application Design
NASA	National Aeronautics and Space Administration
N/A	Not Applicable
OPR	Office of Primary Responsibility
ORR	Operational Readiness Review
PFM	Program Function Model
PR	Problem Report
RDD	Requirements Definition Document
SSCB	Space Station Control Board
SSFP	Space Station Freedom Program
SSFPO	Space Station Freedom Program Office
SSP	Space Station Program
TBD	To Be Determined
TCB	TMIS Control Board
TIEM	TMIS Information Engineering Methodology
TMIS	Technical and Management Information System
TMIS–IC	Technical and Management Information System–Integration Contractor
VDD	Version Description Document

APPENDIX B GLOSSARY

APPLICATION SOFTWARE

Customized software component developed for use within SSFP by the TMIS-IC or other developer.

AS BUILT

The baselined configuration (including documentation and software) of the product or data base application as released into production.

BASELINE

A configuration identification document or set of documents formally designated and fixed at a specific time during a configuration item's life cycle. Baselines, plus approved changes from those baselines, constitute the current configuration identification.

BLOCKPOINT

A scheduling technique whereby a collection of developed, acquired, customized, integrated, and/or maintained software and/or hardware items are released into production on a single day.

CERTIFICATION

The process by which a TMIS release is determined to be acceptable from functional, technical, and security points of view.

COMPONENT

One of the three parts making up an information system: hardware, software or operational procedures, or a portion of a higher level component of the same type.

CONFIGURATION MANAGEMENT

The process of maintaining control of the TMIS configuration of hardware, software, and communications components.

COTS

Commercial-off-the-shelf products acquired for the purpose of integration into the TMIS environment.

CUSTOMIZING

Enhancement and/or modification of COTS products, prior to installation in the production TMIS environment, to meet the requirements of the TMIS user community.

EMERGENCY

A condition in which a group of TMIS users is prevented from doing essential Space Station Freedom work because of a TMIS malfunction of some kind. Must be addressed on a higher priority than any other TMIS activity.

ENABLING

The documentation that establishes and implements the life cycle process. It is used rather than the word "implementing" because of the use and implied meaning of "implementation" in the life cycle process.

FORMAL TEST

A test conducted in accordance with test plans and procedures approved by NASA and witnessed by an authorized NASA representative to verify that the product satisfies specified requirements.

IMPLEMENTATION

The definition of this term includes requirements determination and product specification functions as well as the development, test, deployment, and on-going operation and sustaining engineering functions.

INCREMENT

The stage of Space Station Freedom development that a TMIS release is designated to support.

INFORMAL TEST

Any test conducted by a developer but not witnessed by an authorized NASA representative. These tests use detailed test cases and procedures that were not previously approved by NASA but are available for NASA review upon request.

INTEGRATION

Adaptation of developed or COTS software or hardware components for use with the TMIS suite of systems. Integration may have an implicit requirement for optimizing the components' performance in relation to the full TMIS system.

MAINTENANCE

Enhancements, modifications, and fixes to production software, whether they be TMIS developed or COTS customized.

PRODUCT

Data base applications, or system software, hardware, or network components which are procured (COTS) or developed for use in TMIS.

PRODUCT ASSURANCE

The process by which management assures that high quality is built into the components of the TMIS suite of systems.

PROGRAMWIDE DATA BASES

All data bases to be shared among SSFP levels I, II, and III; NASA centers; other organizations; and International Partners.

PROTOTYPE

A model depicting a proposed application that is used to define and/or clarify user requirements.

REGRESSION TEST

Tests conducted on portions of an application that have not changed. These tests are conducted when other related software enhancements are applied. They are run to ensure that test cases and procedures produce the same results as before the enhancement.

SOFTWARE

Computer code, including firmware, and its associated documentation. For the purposes of this procedure, software will be categorized as either developed or COTS system software or data base application software.

SOFTWARE ENHANCEMENT

Any new operational capability added to previously operational software. Typically, this software will have been entered into the TMIS Product Baseline and is under control of the TMIS CM organization.

SYSTEM SOFTWARE

Software component that provides basic, generic computing capabilities such as the operating system, network, and data base capabilities.

TESTING

The process of exercising or evaluating an information system or component by either manual or automated means to demonstrate that it satisfies specified requirements or to identify differences between expected and actual results.

SPACE STATION FREEDOM PROGRAM OFFICE
THE TMIS LIFE CYCLE PROCESS DOCUMENT

LIST OF CHANGES

NOVEMBER 1991

All changes to paragraphs, tables, and figures in this document are shown below:

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH
BB003037	09-06-91	REVISION A	ALL

